



NuWave Sensors TD40v2.1.1 Particle Counter Setup and Configuration Manual



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1.0 Introduction and Specification Overview

The TD40v2.1.1 measures particles from 0.35 to 40 µm in diameter using a laser-based particle sensor and pump-less air flow system. An LCD display provides on board display of PM1, PM2.5 & PM10 values and wireless connectivity provides remote monitoring access for detailed analysis of PM readings, real time particle size histograms as well as temperature and humidity monitoring.

The TD40v2.1 measures the light scattered by individual particles carried in a sample air stream through a laser beam. These measurements are used to determine the particle size (related to the intensity of light scattered via a calibration based on Mie scattering theory) and particle number concentration. Particle mass loadings- PM1 PM2.5 or PM10, are then calculated from the particle size spectra and concentration data, assuming a particle density and refractive index (RI).



Output	Particle Measurement	PM 1, PM 2.5 and PM 10
Size categorisation	Number of software bins	24
Particle size range	µm spherical equivalent size	0.35 – 40 µm
Total Flow Rate	Air passing through sensor	5.5 L/min
Particle count rate	Max number per second	10,000
Max coincidence probability	%concentration at 106 particles	0.84
	%concentration at 500 particles/L	0.24
Laser	Laser class	Class 1
Calibration	NIST traceable	Yes
Certification & Compliance		

2.0 Sensor Operation

2.1 How it works:

The TD40v2.1 classifies each particle size, recording the particle size to one of 24 software “bins” covering the size range from 0.35 to 40 μm . The resulting particle size histograms can be evaluated using the online web interface.

All particles, regardless of shape are assumed to be spherical and are therefore assigned a ‘spherical equivalent size’. This size is related to the measurement of light scattered by the particle as defined by Mie theory, an exact theory to predict scattering by spheres of known size and refractive index (RI). The TD40v2.1 is calibrated using Polystyrene Spherical Latex Particles of a known diameter and known RI.

2.2 PM Measurements

The particle size data recorded by the TD40v2.1 sensor can be used to calculate the mass of airborne particles per unit volume of air, normally expressed as $\mu\text{g}/\text{m}^3$. The accepted international standard definitions of particle mass loadings in the air are PM₁, PM_{2.5} and PM₁₀. These definitions relate to the mass and size of particles that would be inhaled by a typical adult. So, for example, PM_{2.5} is defined as ‘particles which pass through a size-selective inlet with a 50% efficiency cut-off at 2.5 μm aerodynamic diameter’. The 50% cut-off indicates that a proportion of particles of larger than 2.5 μm will be included in PM_{2.5}, the proportion decreasing with increasing particle size, in this case out to approximately 10 μm particles.

The TD40v2.1 calculates the respective PM values according to the method defined by European Standard EN 481. Conversion from the ‘optical size’ of each particle as recorded by the TD40v2.1 and the mass of that particle requires knowledge of both particle density and its RI at the wavelength of the illuminating laser beam, 658 nm. The latter is required because both the intensity and angular distribution of scattered light from the particle are dependent on RI. The TD40v2.1 assumes an average RI value of $1.5 + i0$.

Notes • The TD40v2.1 calculations of particle mass assume a negligible contribution from particles below approximately 0.35 μm , the lower limit of particle detection of the TD40v2.1 sensor. • The EN 481 standard definition for PM₁₀ extends to particle sizes beyond the upper measurable size limit of the TD40v2.1. In some cases, this can result in the reported PM₁₀ value being underestimated by up to ~10%.

3.0 Hardware Configuration

The TD40v2.1 connects to the online monitoring system using Zigbee wireless communication. This enables multiple sensors to be installed and communicate back to a wireless gateway which converts wireless data to a single Ethernet point.

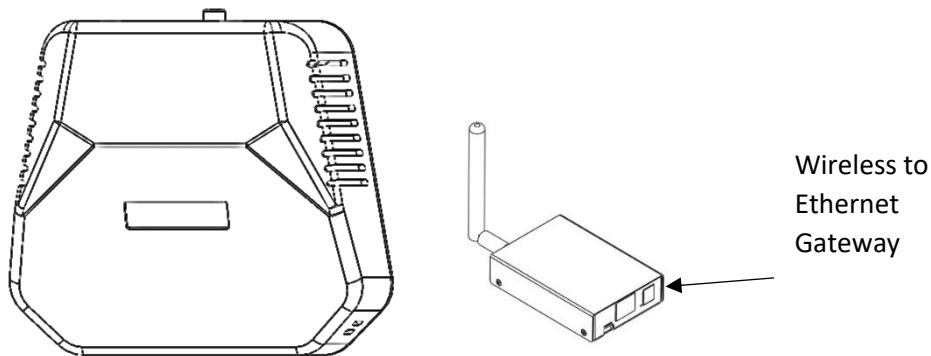
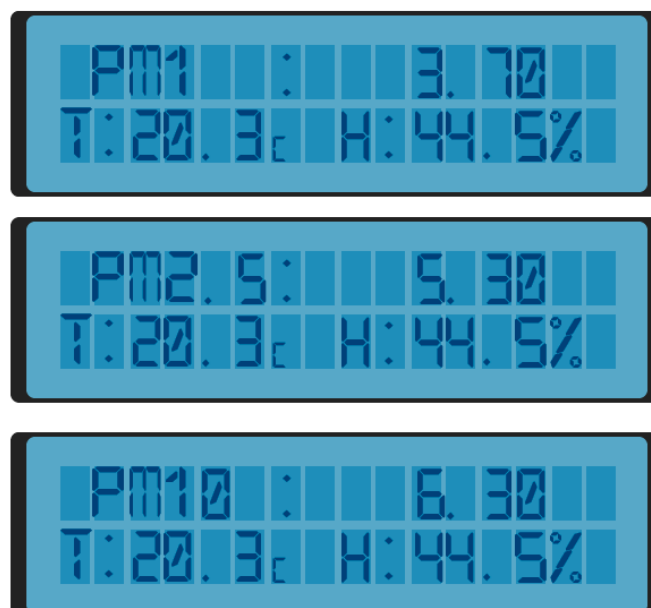


Fig 2. TD40v2.1 Sensor with Wireless to Ethernet Data Gateway

3.1 LCD Display

The LCD displays the current temperature and humidity and cycles through a view of each PM value (PM1, PM2.5 & PM10) as follows;

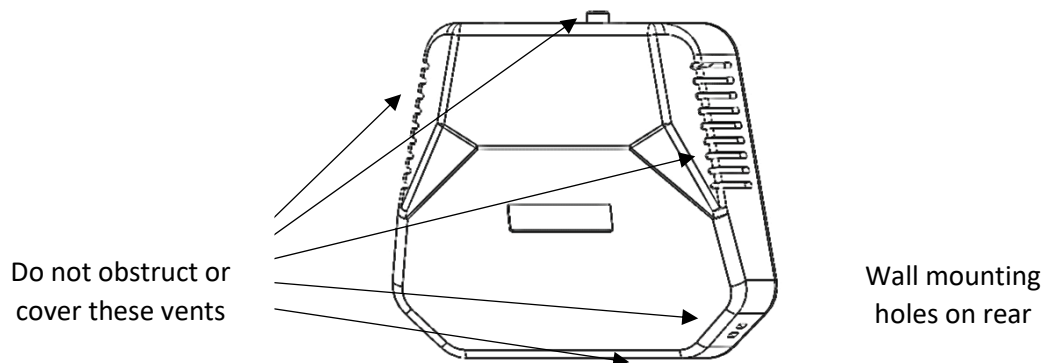


3.2 Where Best to Place the TD40v2.1 System

The TD40v2.1 system continuously samples the air in its immediate vicinity, and throughout the day considering the migration of air in a room will monitor a wide area around the device. However, for optimum usage the system should be placed close to sources of particle contamination.

The unit can be wall mounted using the sensor enclosure mounting holes or placed flat on a desk or worktop.

Note: Do not place the sensor upright on a desk as this will obstruct the flow of air to the temperature and humidity sensors which are at the bottom of the unit.



4.0 Power Supply

The TD40v2.1 is supplied with a 12V DC power supply. The converter operates at 100 – 240VAC on its input and is compatible with the mains power network of most continents.



5.0 Internet Connection

5.1 Wireless Ethernet Gateway Connection

Your wireless sensor will need to be in range of the Data Hub gateway – this range can vary per building from 20 metres to 100 metres depending on building fabric

- To set up the gateway please connect the Ethernet cable provided to the Gateway and then connect to an Ethernet point or a spare Ethernet port on your router.
- Power on the device after connecting the supplied power supply. The device will power on automatically and establish a connection with the TD40v2.1 Sensor.

5.2 Network Configuration:

The gateway will also by default automatically configure itself to your network settings using DHCP.

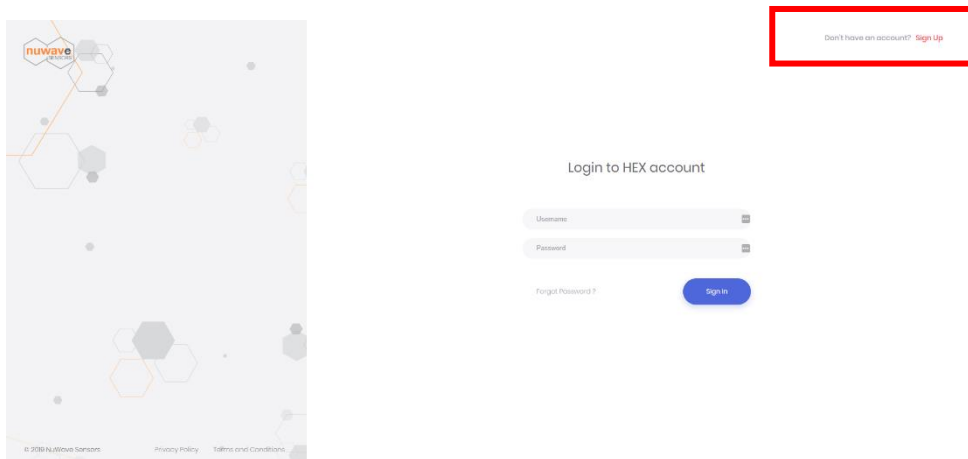
It is possible to configure the sensor to connect to a static IP address. Please see page 12 of this manual to complete this step.

6.0 Online Software Setup

6.1 Online account set up

To set up your online account to remotely monitor your TD40v2.1 please navigate to <https://hex2.nuwavesensors.com> on your computer internet browser.

On the webpage you will be prompted to sign in or create an account. As this is your first time to access the account please click 'Create Account' just under the sign in section.



6.2 Account Sign up

Please complete the form in order to complete the sign-up process. If you have any issues please contact support: info@nuwavesensors.com quoting the serial number of your sensor and gateway (found on the sticker on the back of both devices).

Create Account

Required: 150 characters or fewer. Letters, digits and @/!/+/-/_ only.

- Your password can't be too similar to your other personal information.
- Your password must contain at least 8 characters.
- Your password can't be a commonly used password.
- Your password can't be entirely numeric.

Enter the same password as before, for verification.

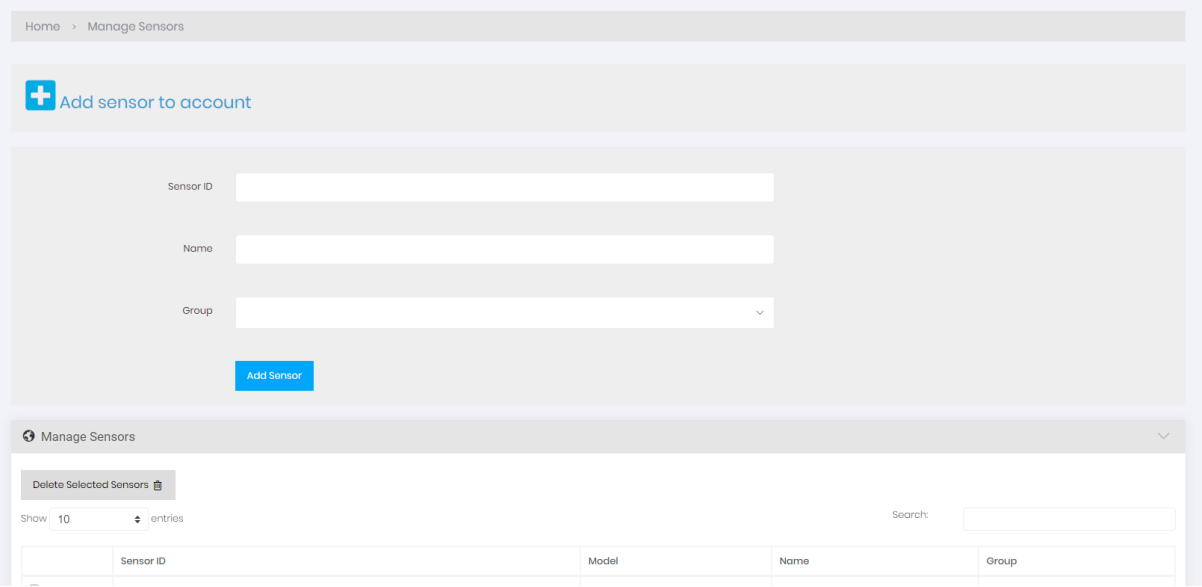
7.0 Setting up your first sensor using your online account

7.1 Adding a sensor

After logging in for the first time the first page you will see is the **Home Page** – where you can add a new sensor and view the list of installed sensors.

To add your new sensor, click **'Add Sensor'** and complete the form based on your sensor details;

- **Sensor Id:**
Please enter a 16-digit sensor ID (located on the back of the sensor)
- **Sensor Name:** Example; Cleanroom 2A
- **Sensor Group:** Completing this field allows you to create groups of sensors based on your preference –example; 1st Floor. You can also leave this blank if you do not wish to create a group.



The screenshot shows the 'Manage Sensors' page. At the top, there is a breadcrumb 'Home > Manage Sensors'. Below this is a blue button with a plus icon and the text 'Add sensor to account'. The main form contains three input fields: 'Sensor ID', 'Name', and 'Group'. The 'Group' field is a dropdown menu. Below the form is a blue 'Add Sensor' button. At the bottom of the page, there is a 'Manage Sensors' section with a 'Delete Selected Sensors' button, a 'Show 10 entries' dropdown, a search bar, and a table with columns for 'Sensor ID', 'Model', 'Name', and 'Group'.

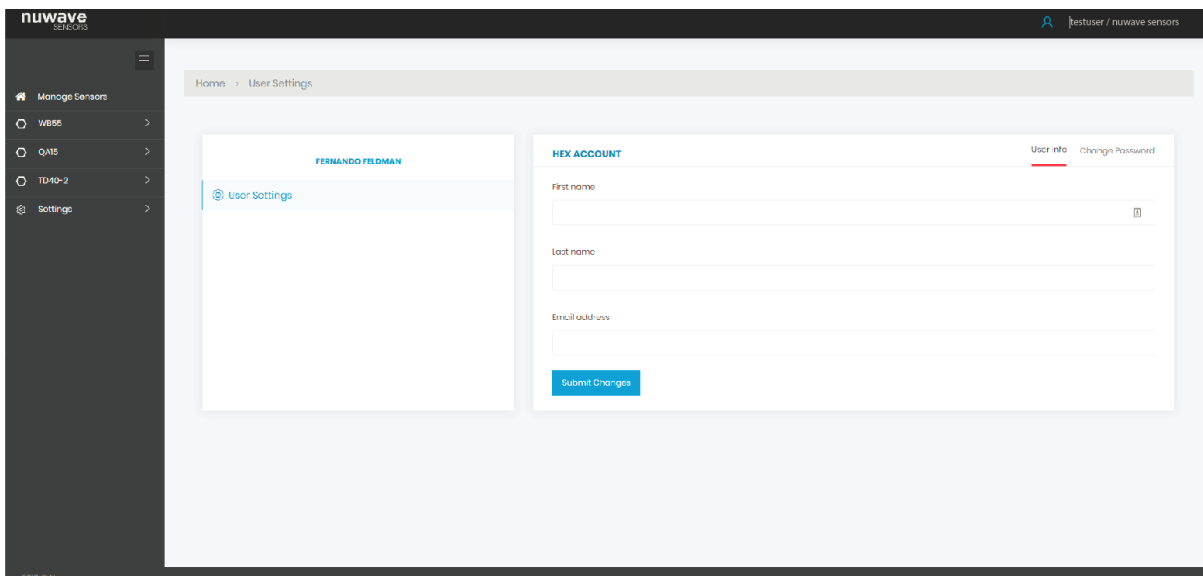
Once you have completed the above form click **'Add Sensor'** button at the end of the form and your sensor will be added. To add another sensor at any time, please repeat the steps above.

8.0 User Profile Settings

On the settings page you can edit and manage your user account details including;

- Change Password
- Change e-mail address associated with the account
- Address Location

Once any changes have been made click the 'Submit Changes' button.

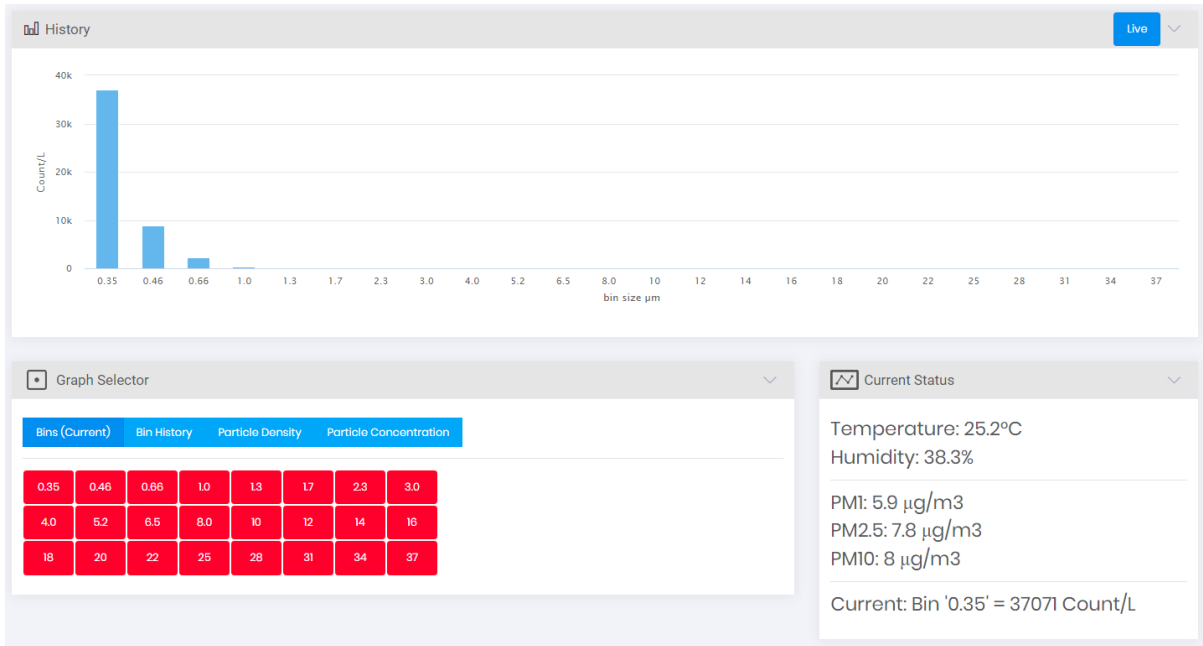


9.0 Online Monitoring Dashboard

9.1 Current Particle Bin View

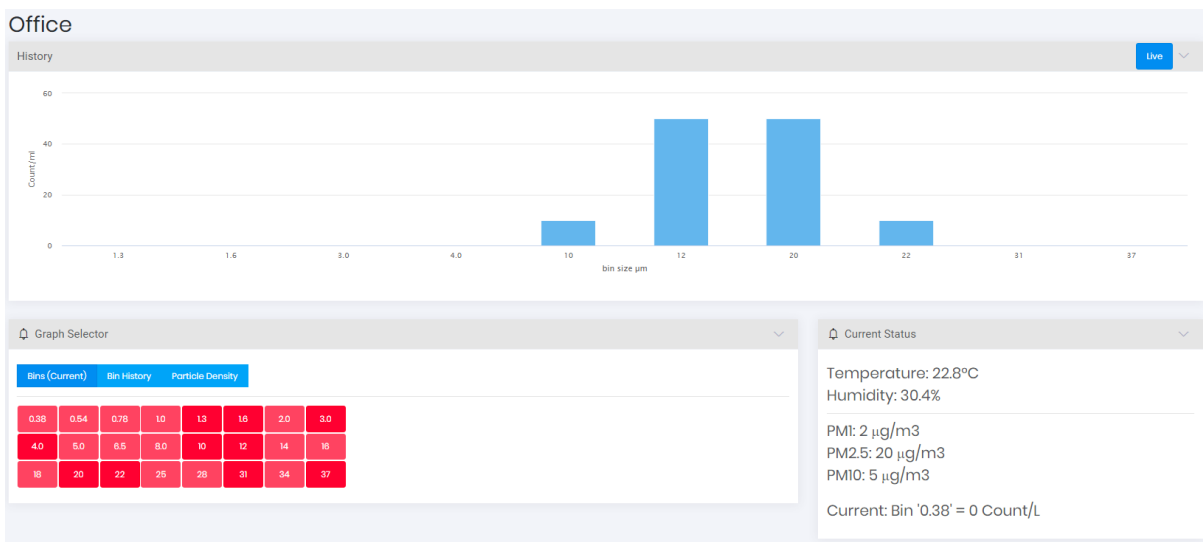
From here users can;

- View all current particle bin readings using histogram view
- View current status of PM1, PM2.5, PM10 values
- View current temperature and humidity levels



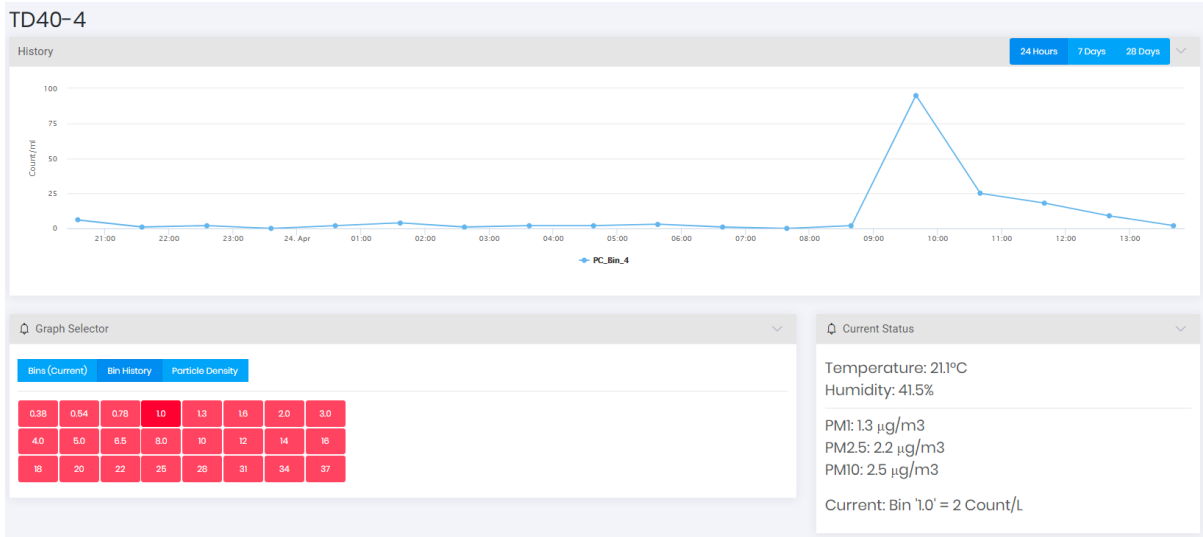
9.2 Particle Bin comparison feature

Using this feature users can compare two particle bins using the bin selector buttons underneath the bar chart by selecting / de-selecting individual particle bins



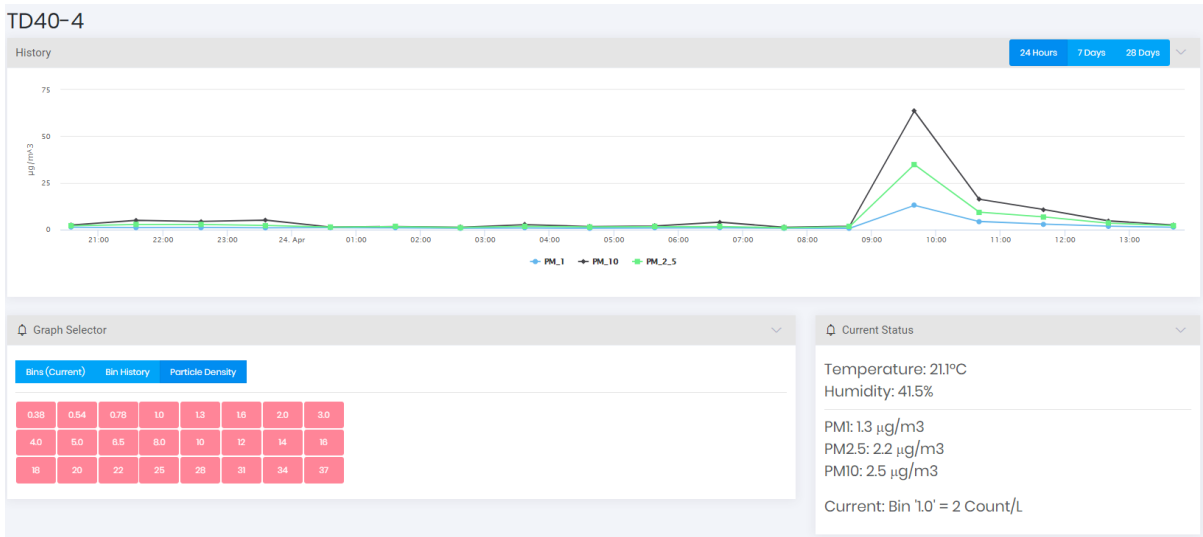
9.3 Particle Bin History

- View detailed bin history by day, week or month Select bin history by particle size using particle size selector buttons underneath graph



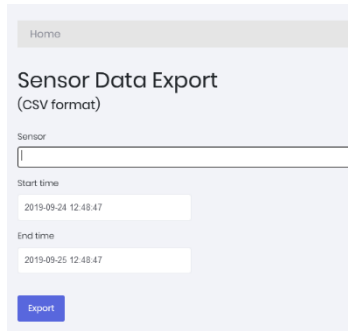
9.4 Particle Density Graph View

- View particle density graphs by day, week or month



9.5 Export Data Feature

- Export data for detailed offline analysis. Data is e-mailed to the account holders e-mail address which is in the User profile settings page.
- CSV format



Home

Sensor Data Export (CSV format)

Sensor

Start time

2019-09-24 12:48:47

End time

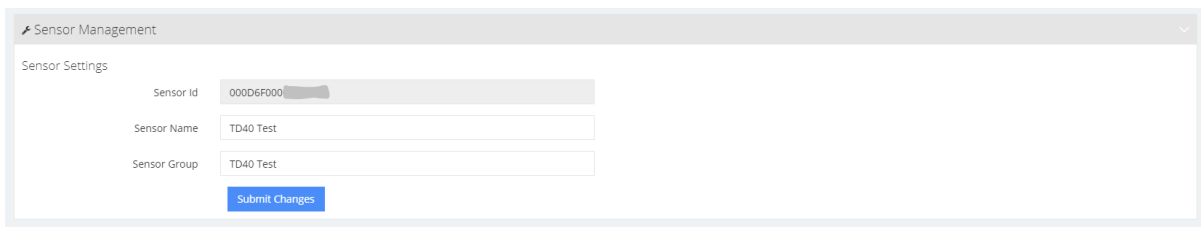
2019-09-25 12:48:47

Export

9.6 Sensor Naming Settings

At the bottom of each sensor you will find the sensor management settings. From here you can manage settings such as re-naming the sensor and group.

Note: To save and changes make sure and click ‘Save Changes’ at the bottom of the form.



Sensor Management

Sensor Settings

Sensor Id 000D6F000

Sensor Name TD40 Test

Sensor Group TD40 Test

Submit Changes

10.0 Gateway Network Configuration

The DATA HUB gateway is configured to use DHCP by default. This automatically detects network settings on most standard networks and the sensor will be able to send data online without changing any settings.

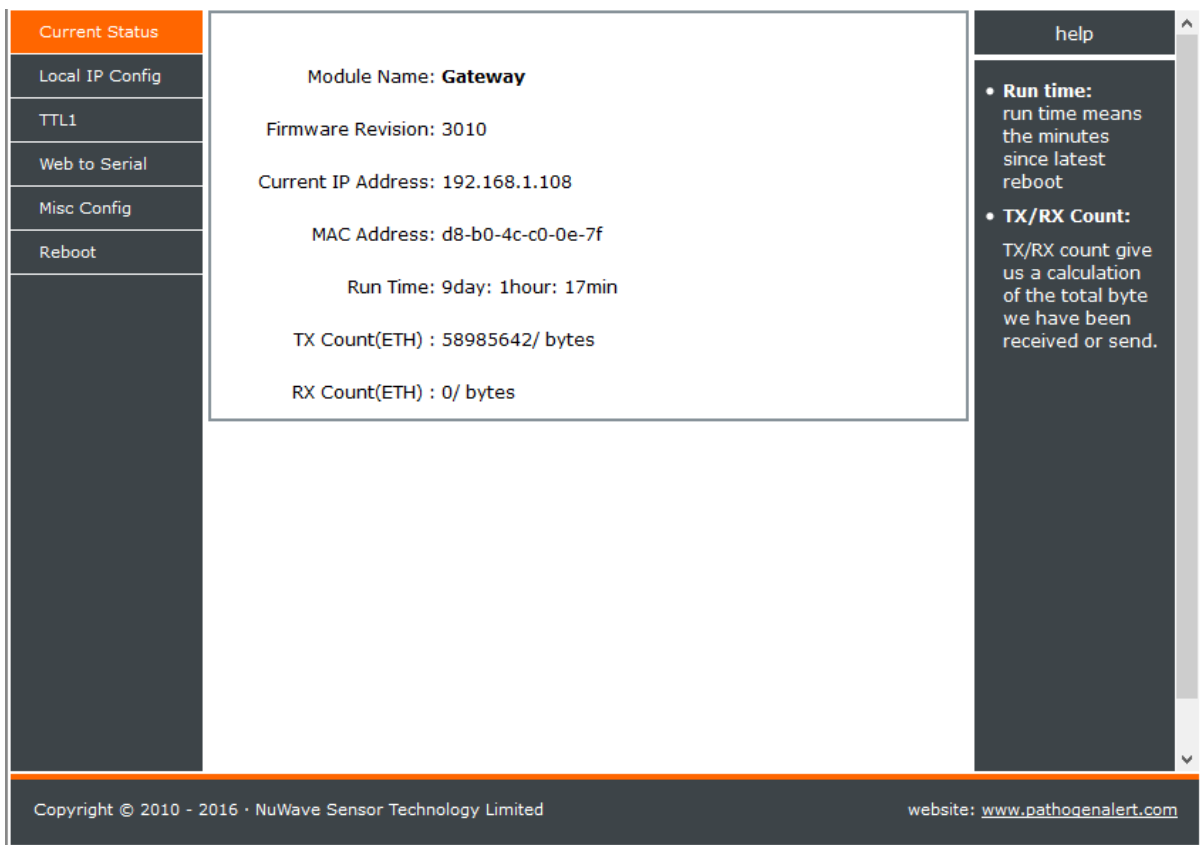
You can edit the network settings and assign a static IP using the gateway web interface of the gateway which is accessible using an internet browser. To access the gateway you must know the IP address which can be found using the MAC address of the gateway (located on the bottom of gateway).

When prompted, enter the following username and password;

Username: admin

Password: admin

If you have any issues, please contact info@nuwavesensors.com



Current Status	<p>Module Name: Gateway</p> <p>Firmware Revision: 3010</p> <p>Current IP Address: 192.168.1.108</p> <p>MAC Address: d8-b0-4c-c0-0e-7f</p> <p>Run Time: 9day: 1hour: 17min</p> <p>TX Count(ETH) : 58985642/ bytes</p> <p>RX Count(ETH) : 0/ bytes</p>	help
Local IP Config		<ul style="list-style-type: none"> • Run time: run time means the minutes since latest reboot • TX/RX Count: TX/RX count give us a calculation of the total byte we have been received or send.
TTL1		
Web to Serial		
Misc Config		
Reboot		
<p>Copyright © 2010 - 2016 · NuWave Sensor Technology Limited</p> <p style="text-align: right;">website: www.pathogenalert.com</p>		

Figure 1 - Gateway Homepage



Current Status	<p>IP type: <input type="text" value="DHCP/AutoIP"/></p> <p>Static IP: <input type="text" value="192"/> · <input type="text" value="168"/> · <input type="text" value="0"/> · <input type="text" value="7"/></p> <p>Submask: <input type="text" value="255"/> · <input type="text" value="255"/> · <input type="text" value="255"/> · <input type="text" value="0"/></p> <p>Gateway: <input type="text" value="193"/> · <input type="text" value="168"/> · <input type="text" value="0"/> · <input type="text" value="100"/></p> <p><input type="button" value="Save"/> <input type="button" value="Cancel"/></p>	help
Local IP Config		<ul style="list-style-type: none">• IP type: StaticIP or DHCP• StaticIP Module's static ip• Submask usually 255.255.255.0• Gateway Usually router's ip address
TTL1		
Web to Serial		
Misc Config		
Reboot		

Copyright © 2010 - 2016 · NuWave Sensor Technology Limited website: www.pathogenalert.com

Figure 2 - Gateway IP Configuration

Current Status	Baud Rate: <input type="text" value="19200"/> bps Data Size: <input type="text" value="8"/> bit Parity: <input type="text" value="None"/> <input type="text" value="v"/> Stop Bits: <input type="text" value="1"/> bit Flow Control and RS485: <input type="text" value="None"/> <input type="text" value="v"/> Local Port Number: <input type="text" value="23"/> Remote Port Number: <input type="text" value="58122"/> Work Mode: <input type="text" value="TCP Client"/> <input type="text" value="None"/> <input type="text" value="v"/> Remote Server Addr: <input type="text" value="gateway.nuwavesensordata.com"/> [52.51.149.87] Timeout: <input type="text" value="0"/> seconds (< 256, 0 for no timeout) UART packet Time: <input type="text" value="0"/> ms (< 256) UART packet length: <input type="text" value="0"/> chars (<= 1460, 0 for no use) Sync Baudrate(RF2217 similar): <input type="checkbox"/>	help
Local IP Config		<ul style="list-style-type: none"> • baud: 300~1024000bps(2 and 485 can only up to 115200bps) • flowcontrol and RS485 default RS485 • local port 1~65535. when TCP Client, set this to 0 means use random local port • remote port 1~65535 • packet time 1~255ms,default 10ms;when baud <=4800bps, pls set packet time to 50 ms
TTL1		
Web to Serial		
Misc Config		
Reboot		
<input type="button" value="Save"/> <input type="button" value="Cancel"/>		
Copyright © 2010 - 2016 · NuWave Sensor Technology Limited		website: www.pathogenalert.com

Figure 3 - Gateway TTL Configuration Page

Current Status	Module Name: <input type="text" value="Gateway"/>  UPnP port number: <input type="text" value="6432"/> weberver port number: <input type="text" value="80"/> Module Id(use for indentify modue): <input type="text" value="1"/> (1~65535) Module Id type: <input type="text" value="0"/> (0/1/2/3) MAC Address: <input type="text" value="d8-b0-4c-c0-0e-7f"/> User name: <input type="text" value="admin"/> Pass word: <input type="password" value="admin"/> 	help
Local IP Config		<ul style="list-style-type: none"> • module name max length is 15 char • Web port default 80 • ID and ID type we could use it for D2D • Mac address user could modify this MAC address
TTL1		
Web to Serial		
Misc Config		
Reboot		
<input type="button" value="Save"/> <input type="button" value="Cancel"/>		

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website: www.pathogenalert.com

Figure 4 - Gateway Misc Config

11.0 Appendix

11.1 TD40v2.1 Maintenance and calibration

The TD40v2.1 is shipped pre-calibrated. There are no user serviceable parts.

Calibration Interval:

Calibration is required typically every 2 years by returning the sensor to NuWave Sensors for a service.

11.2 Important Precautions

The TD40v2.1 should be protected from certain external influences. Namely;

- The unit should not be placed near anywhere that may leak from above (unit is not IP68 rated)
- The unit should not be wet cleaned with cleaning products
- The output vents should not be blocked for any reason

11.3 Troubleshooting

Problem	Possible Issue		Solution
No data arriving online after 15 minutes	1	Ethernet Cable not firmly connected on data hub	Power off both the DATA HUB and TD40v2.1 SENSOR by plugging out the power supplies. Please ensure that the Ethernet cable is firmly connected to both the DATA HUB gateway and the port on your broadband router. Apply power to both devices and check to see if data arrives after 15 minutes.
	2	Outside of wireless range	The wireless range of the sensor can vary greatly depending on the building fabric and can vary by as much as 20m to 100m. To test this please plug the TD40v2.1 in close range to the DATA HUB. Data should arrive online once the solution to issue number 1 above has been tested.

For all other queries please contact info@nuwavesensors.com stating the issue you having. Please provide as much detail as possible.

11.4 Important Precautions

Caution! This device is recommended for use indoors and in a dry location only.

- Take care when using TD40v2.1 to route the power cable in a way that reduces the risk of injury to others, such as by tripping or choking.
- Do not cover or obstruct vents around the TD40v2.1 sensor.
- Only use the power adapter supplied with TD40v2.1.
- Do not insert anything through the vents.
- Do not inject gas, dust or chemicals directly into the TD40v2.1 sensor.
- Do not use this device near water.
- Do not drop or subject the device to undue shock.
- Do not place in insect-infested areas. Insects can block vent openings to the sensors.

Apart from periodic calibration (see 11.1) the TD40v2.1 is designed to be maintenance free, but you should keep it clean and avoid dust build up - especially around the air vents of the sensor which can reduce performance.

To clean TD40v2.1:

1. Turn off mains power and remove the power adapter plug from TD40v2.1.
2. Wipe the outside with a clean, slightly damp cloth. Don't use soap or solvents!
3. Very gently vacuum around the vents of the TD40v2.1 sensor to remove dust obstructing the vent openings.

Note:

- Never use detergents or solvents on your TD40v2.1 sensor or spray air fresheners, hair spray or other aerosols near it.
- Do not allow water get inside the TD40v2.1 sensor.
- Do not paint your TD40v2.1 sensor.

11.5 Recycling and disposal

The TD40v2.1 should be disposed of separate from ordinary household waste at the end of its life in accordance with local regulations. Please take TD40v2.1 to a collection point designated by your local authority to be recycled to help conserve natural resources.

11.6 Product Warranty

Limited Product Warranty

THIS LIMITED WARRANTY CONTAINS IMPORTANT INFORMATION ABOUT YOUR RIGHTS AND OBLIGATIONS, AS WELL AS LIMITATIONS AND EXCLUSIONS THAT MAY APPLY TO YOU AS PART OF THE TERMS AND CONDITIONS OF SALE IN EFFECT AT THE TIME THAT YOU PURCHASE A NUWAVE SENSOR TECHNOLOGY LIMITED PRODUCT.

What this warranty covers?

NuWave Sensor Technology Limited (“NuWave”) warrants to the original purchaser of this TD40v2.1 sensor (the “Product”) shall be free of defects in design, assembly material, or workmanship under normal use for a period of one (1) year from the date of purchase (the “Warranty Period”). NuWave does not warrant that the operation of the Product will be uninterrupted or error-free. NuWave is not responsible for damage arising from failure to follow instructions relating to the Product’s use. This Limited Warranty does not cover software embedded in the Product and the services provided by NuWave to owners of the Product. Refer to the licence agreement accompanying the software for details of your rights with respect to their use.

Remedies

NuWave will repair or replace, at its option, any defective product free of charge (except for shipping charges for the product). Any replacement hardware product will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer. In the event that NuWave is unable to repair or replace the product (for example, because it has been discontinued), NuWave will offer either a refund or a credit towards the purchase of another product from NuWave in an amount equal to the purchase price of the product as evidenced on the original purchase invoice or receipt.

What is not covered by this warranty?

The warranty is null and void if the Product is not provided to NuWave for inspection upon NuWave’s request, or if NuWave determines that the Product has been improperly installed, altered in any way, or tampered with. The NuWave Product Warranty does not protect against floods, lightning, earthquakes, war, vandalism, theft, normal-use wear and tear, erosion, depletion, obsolescence, abuse, damage due to low voltage disturbances such as brownouts, non-authorized program or system equipment modification, alternation or other external causes.

How to Obtain Warranty Service

Please review the online help resources at nuwavesensors.com/support prior to seeking warranty service. To get service for your TD40v2.1 sensor you must take the following steps;

1. Contact NuWave Sensors customer support. Customer Support contact information can be found by visiting www.nuwavesensors.com/support
2. Provide the following to the customer support agent;
 - a. The serial number found on the back of your TD40v2.1 sensor
 - b. Where you purchased the product
 - c. When you purchased the product
 - d. Proof of payment
3. Your customer service representative will then instruct you on how to forward your receipt and your TD40v2.1 as well as how to proceed with your claim.



It is likely that any stored data relating to the product will be lost or reformatted during service and NuWave will not be responsible for any such damage or loss.

NuWave reserve the right to review the damaged NuWave product. All costs of shipping the Product to NuWave for inspection shall be borne by the purchaser. Damaged equipment must remain available for inspection until the claim is finalised. Whenever claims are settled NuWave reserves the right to be subrogated under any existing insurance policies the purchaser may have.

Implied Warranties

EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, ALL IMPLIED WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) SHALL BE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY.

Some jurisdictions do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you.

Limitation of Damages

IN NO EVENT SHALL NUWAVE BE LIABLE FOR INCIDENTAL, SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL OR MULTIPLE DAMAGES SUCH AS, BUT NOT LIMITED TO, LOST BUSINESS OR PROFITS ARISING OUT OF THE SALE OR USE OF ANY NUWAVE PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Statutory Rights

This warranty gives you specific legal rights, and you may have other rights, depending on your jurisdiction. These rights are not affected by the warranties in this Limited Warranty.